PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-241364

(43)Date of publication of application : 08.09.2000

(51)Int.Cl. G01N 22/00
B67D 1/12

(21)Application number : 11-042684

(22)Date of filing : 22.02.1999

(71)Applicant : MITSUBISHI HEAVY IND LTD

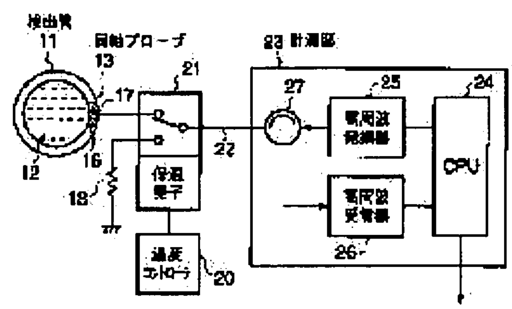
(72)Inventor : UCHIDA TOYOICHI

(54) MEASURING APPARATUS FOR CONCENTRATION OF LIQUID AND CONTROL DEVICE FOR CONCENTRATION FOR DRINK FILLING

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a measuring apparatus, for the concentration of a liquid, which is excellent in corrosion resistance and vibration-proofness, which is of high accuracy and which obtains high reliability.

SOLUTION: A single coaxial probe 13 is attached to a detecting pipe 11 in which a liquid 12 to be measured flows in its inside. In a measurement, microwaves are output from a high-frequency oscillator 25, and they are input to the center conductor 17 of the coaxial probe 13 via a circulator 27, a connecting cable 22 and a changeover switch 21. The microwaves which are input to the center conductor 17 from its tip are radiated to the liquid 12 from its tip, and a part is reflected by the interface of the liquid according to its concentration so as to be sent to a high-frequency receiver 26 via the changeover switch 21, the connecting cable 22 and the circulator 27. The receiving 26 detects the intensity and the phase of reflected waves which are sent from the coaxial probe 13, and the intensity and the phase are input to a CPU 24. The CPU 24 finds the relative permittivity of the liquid 12 on the basis of the intensity and the phase of the reflected waves, and it calculates the concentration of the liquid.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the concentration control unit for drink restoration which controls liquid concentration to constant value using the liquid density measurement equipment which detects the concentration of the liquid filled with a drink restoration machine etc., and this liquid density measurement equipment.
[0002]
[Description of the Prior Art] By the drink restoration machine, in case containers, such as a glass bottle and a PET bottle, are filled up with a drink, for example, the concentration of the drink with which it is filled up is measured with liquid density measurement equipment, and concentration control is performed so that a container may be filled up with the drink of proper concentration based on the measurement result. Conventional liquid density measurement equipment is constituted as shown in drawing 10 .
[0003] In drawing 10 , 1 is a detection pipe for detecting liquid concentration, and the liquids 2, such as a drink, flow all over the passage. The electrodes 3a and 3b of a couple are attached in the above-mentioned detection pipe 1 so that it may be symmetrically got blocked in the diameter direction and it may be countered to passage. And a RF 100MHz or less is impressed from the RF impression circuit 4 between above-mentioned electrode 3a and 3b, the alternating current impedance change at that time is detected by the digital disposal circuit 5, and concentration conversion is carried out. In this case, the capacitance C at the time of being the case where a liquid 2 enters between electrode 3a and 3b will be called for by the following formula C=omega epsilon/d, if the interval between epsilon, electrode 3a, and 3b is set to d for the dielectric constant of a liquid 2. An alternating current impedance's changing is that capacitance C changes, and it shows that the dielectric constant epsilon of a liquid 2 changes. Therefore, by the digital disposal circuit 5, by measuring capacitance C, the dielectric constant epsilon of a liquid 2 can be computed and it can ask for liquid concentration.
[0004] Moreover, in addition to this, there are JP,5-322879,A, JP,10-142168,A, JP,8-220024,A, etc. as conventional liquid density measurement equipment. It reached, and it is gas concentration simultaneous measurement equipment, and above-mentioned JP,5-322879,A has measured gas concentration and the sugar content for measurement of the concentration of a drink liquid using the degree property of propagation of an ultrasonic wave, using the sugar content in the drink in an airtight container, and the property that it is decided with the internal pressure of an airtight container that container rigidity will be measurement of the gas concentration in a drink liquid. Therefore, it can carry out, without measurement of the gas concentration in a drink liquid and measurement of the sugar content of a drink liquid needing unstopping of an airtight container.
[0005] Above-mentioned JP,10-142168,A is related with the concentration meter which measures the concentration of a measured fluid by detecting the phase contrast of the microwave which spread the measured fluid, and the signal which does not spread a measured fluid. Namely, emit the microwave of frequency f1 to a measured fluid from the 1st microwave oscillator, and it receives by the receiving

antenna. Mix the microwave with the 2nd microwave (frequency f2) from the 2nd microwave oscillator, and it changes into the low frequency signal of $|f1-f2|$. Furthermore, the signal which inputs into a phase contrast arithmetic circuit and does not spread a measured fluid after changing this low frequency signal into a square wave in a corrugating circuit, The error which lessens an analog circuit and originates in the property of an analog circuit is lessened, and precision is made to improve by carrying out counting of the phase contrast with the square wave signal from the above-mentioned corrugating circuit using the signal of the reference frequency from criteria VCO.

[0006] Above-mentioned JP,8-220024,A detects the impurity contamination which takes place into the manufacturing process of a semiconductor by life-time measurement of the carrier poured in into the semiconductor, and is related with the measuring method of the pollution high impurity concentration of the semiconductor which measures the concentration of a pollution impurity, and its equipment. Namely, irradiate a laser beam in the shape of a pulse at the semiconductor sample by which microwave was irradiated, and a carrier is poured into a semiconductor sample. In the measuring method of the pollution high impurity concentration of a semiconductor which detects the microwave reflected or penetrated from the above-mentioned semiconductor sample, and detects the concentration of the pollution impurity in a semiconductor sample by measuring the life time of the above-mentioned carrier from a time change of the intensity When the bias light to which the state of the pollution impurity of the above-mentioned semiconductor sample is changed is irradiated, By measuring the life time when not irradiating, respectively and comparing the life time when irradiating the above-mentioned bias light with the life time when not irradiating bias light It is what detected the contamination concentration of the above-mentioned semiconductor sample, and the concentration of the pollution impurity which does not include the influence of the defect of a semiconductor etc. can be detected from measurement of a life time.

[0007]

[Problem(s) to be Solved by the Invention] The conventional liquid density measurement equipment shown in drawing 10 has the problem of becoming cost quantity while it needs to embed Electrodes 3a and 3b with high degree of accuracy in the detection pipe 1 and needs an advanced manufacturing technology, since the interval of Electrodes 3a and 3b influences the accuracy of measurement greatly.

[0008] Moreover, the measuring device shown in JP,5-322879,A, JP,10-142168,A, and JP,8-220024,A has the problem that circuitry becomes very complicated.

[0009] Moreover, there are (1) light refractive-index meter, (2) conductivity meters, (3) ultrasonic-wave acoustic velocity meter, (4) mass flowmeters, etc. conventionally as other liquid density measurement equipments. Since glass is used for the optical refractive-index meter of the above (1) in order to make light penetrate although the liquid which touches a glass side, and a reflection factor compute concentration using changing with the concentration of a liquid, an error arises in reflection factor measurement by the glass's being corroded by the cleaning agent of an alkali system, or becoming dirty.

[0010] In the conductivity meter of the above (2), there are some for which the conductivity of a liquid depends on concentration. In this case, although densitometry is possible if the conductivity of a liquid is measured, what has small conductivity is immeasurable.

[0011] The ultrasonic acoustic velocity meter of the above (3) may be uniquely immeasurable with a convex type or the concave maximum minimum point depending on a liquid, although ultrasonic acoustic velocity is measured and it asks for concentration by measuring the propagation distance of the ultrasonic wave of the interval as which known was determined using ultrasonic acoustic velocity changing with the concentration of a liquid.

[0012] Although the mass flowmeter of the above (4) measures the temperature change of a liquid by the variation of Coriolis force, if it installs adjacently, vibration currently used in order to detect Coriolis force within other mass flowmeters, a place with vibration and will be transmitted, and it will cause an error.

[0013] Moreover, for example in the drink restoration machine, an acid (a sodium hypochlorite and nitric acid), alkali (caustic alkali of sodium), hot water (90-95 degrees C), and steam (140 degrees C) are used for a washing process, and corrosion resistance and thermal resistance are called for.

[0014] this invention is [0015] aiming at offering the liquid density measurement equipment and the concentration control unit for drink restoration with which it was made in order to solve the above-mentioned technical problem, and it excels in corrosion resistance and vibration-proof nature, and highly precise and high reliability is acquired.
[Means for Solving the Problem] The single concentration detector with which the nose of cam of a central conductor is inserted into the aforementioned detection pipe at least while being attached in the detection pipe with which a measured liquid flows inside, and this detection pipe and an insulator's being formed between a central conductor and an outer conductor by the 1st invention, The high-frequency oscillator which sends out microwave to the central conductor of this concentration detector through an interconnection cable, The RF receiver which receives the microwave reflected according to the reflection factor in a liquid interface from the central conductor nose of cam of the aforementioned concentration detector through the aforementioned interconnection cable, and detects the reflectivity and the phase of the aforementioned microwave, It is characterized by providing an operation means to compute the specific inductive capacity of a measured liquid from the reflectivity and the phase of the microwave detected with this RF receiver, and to compute liquid concentration from this specific inductive capacity.
[0016] a measurement value [as opposed to / measure establishing a keeping-warm means to hold the temperature of this circuit changing switch uniformly, and changing the aforementioned circuit changing switch, while the 2nd invention prepares the circuit changing switch which changes the aforementioned interconnection cable to the aforementioned concentration detector or the reflective reference edge of microwave near the detection pipe in the liquid density measurement equipment which is the 1st aforementioned invention, and / a measured liquid] -- an amendment -- it is characterized by things
[0017] The 3rd invention measures the concentration of the drink mixed through the aforementioned flow control valve with the aforementioned claim 1 or liquid density-measurement equipment given in two, and is characterized by to control the opening of the aforementioned flow control valve so that drink concentration turns into target concentration based on the measurement value in the concentration control unit for drink restoration which is mixed through a flow control valve, respectively, adjusts a high-concentration drink and a high-concentration treated water to the drink of target concentration, and fills up a container with it.
[0018]
[Embodiments of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to a drawing.
[0019] (The 1st operation gestalt) Drawing 1 is the block diagram of the liquid density measurement equipment concerning the 1st operation gestalt of this invention. In drawing 1 , 11 is the detection pipe 11 for detecting liquid concentration, and the liquids 12, such as a drink, flow all over the passage. The single coaxial probe 13 which is a concentration detector is attached in the above-mentioned detection pipe 11. As the above-mentioned coaxial probe 13, the RF coaxial connector SMA as shown in drawing 2 is used. While the attachment substrate 15 to the detection pipe 11 is formed in the outside of a conductor 14 outside and the central dielectric 16 is formed inside, as for the above-mentioned coaxial probe 13, a central conductor 17 is formed in the core. The nose of cam of a central conductor 17 has projected the above-mentioned central dielectric 16 and a central conductor 17 from the central dielectric 16 while they are extended and formed in a detection pipe attachment side. The copper wire or the gold streak by which Teflon (tradename) or the ceramic was used, for example, and the surface outcrop was gold-plated as a central conductor 17 as the above-mentioned central dielectric 16 is used. As for the above-mentioned coaxial probe 13, the attachment substrate 15 is fixed to the detection pipe 11 by the screw stop etc. in this case, an O ring intervenes between the detection pipe 11 and the central dielectric 16 -- having -- moreover, the metal section -- soldering -- silver-solder attachment was carried out and pressure resistance is secured
[0020] And the central conductor 17 of the above-mentioned coaxial probe 13 is connected to the measurement section 23 through the circuit changing switch 21 and interconnection cable 22 of two ports. The above-mentioned circuit changing switch 21 is formed near the detection pipe 11. As the

above-mentioned interconnection cable 22, a central dielectric is Teflon (tradename), for example, and a copper semi rigid cable is used for a central conductor. Moreover, one port a is connected to the central conductor 17 of the above-mentioned coaxial probe 13, and, as for the above-mentioned circuit changing switch 21, the port b of another side is grounded through the criteria element 18. As this criteria element 18, 50-ohm resistance is used, for example. The port b of the circuit changing switch 21 which connected the above-mentioned criteria element 18 serves as a reference edge of measurement. This reference edge connects the criteria element 18 as mentioned above, and also is good as an open end or a short circuit edge.

[0021] Usually, since the above-mentioned circuit changing switch 21 and the criteria element 18 have the temperature characteristic, they keep constant the temperature of a circuit changing switch 21 and the criteria element 18 using the temperature controller 20 which controls the temperature of a keeping-warm element / heat sinks 19, such as a BERUCHIE element and a heater, and this the keeping-warm element / heat sink 19, for example, and are attaining stabilization of the temperature characteristic. The above-mentioned criteria element 18, the circuit changing switch 21, and the keeping-warm element / heat sink 19 grade are insulated by the heat insulator from the outside.

[0022] Moreover, the above-mentioned measurement section 23 consists of a coupler 27 which gives a direction at the traveling contact c of a circuit changing switch 21, and combines CPU (microcomputer) 2425, for example, the high-frequency oscillator which generates microwave 300MHz or more, the RF receiver 26 which receives the signal from the above-mentioned coaxial probe 13, the above-mentioned high-frequency oscillator 25, and the RF receiver 26, for example, a circulator.

[0023] In the above-mentioned composition, when measuring the concentration of the liquid 12 which flows the inside of the detection pipe 11, the measurement section 23 outputs microwave 300MHz or more from a high-frequency oscillator 25. This microwave is inputted into the central conductor 17 of the coaxial probe 13 through a circulator 27, an interconnection cable 22, and a circuit changing switch 21. While the microwave inputted into this central conductor 17 is emitted to the liquid 12 which flows the inside of the detection pipe 11 from the open end which is the nose of cam, the part is reflected according to concentration in a liquid interface. This reflected wave is sent to the RF receiver 26 through a circuit changing switch 21, an interconnection cable 22, and a circulator 27. The RF receiver 26 detects the intensity and the phase of a reflected wave which are sent from the coaxial probe 13, and inputs them into CPU24.

[0024] CPU24 compares the intensity and the phase of the microwave outputted from the high-frequency oscillator 25, and a reflected wave, asks for the specific inductive capacity of a liquid 12 based on the comparison result, and computes liquid concentration from this specific inductive capacity. The liquid concentration computed by this CPU24 is outputted and displayed on an output unit, for example, display.

[0025] Since the reflected wave from the coaxial probe 13 is decreased by the interconnection cable 22 or a phase changes on the occasion of the above-mentioned densitometry, the measurement value to a reflected wave is amended by changing the coaxial probe 13 and the criteria element 18 with a circuit changing switch 21, and measuring by turns. namely, the relative variation of the reflection factor by the side of the criteria element 18 -- the reflection factor by the side of a liquid 12 -- a relative amendment -- things -- the amount of change in an interconnection cable 22 -- an amendment -- things are made

[0026] In addition, even if it changes with manual operation, the above-mentioned circuit changing switch 21 is changed from CPU24, and it outputs a signal and you may make it change it automatically.

[0027] It depends on the complex permittivity showing the dielectric constant of a RF field for the reflected wave intensity and the phase in an open end of the central conductor 17 prepared in the above-mentioned coaxial probe 13. The real part of complex permittivity expresses loss of a RF, and imaginary part expresses propagation. Hereafter, the radiation from an effective-area electromagnetic-field distribution of the coaxial probe 13 is explained. for example, the radiation and the conductor from a parabolic antenna -- like diffraction by the hole which was able to be made in the board, the electromagnetic-field distribution on an effective area (Aperture) is given in many cases in approximation at least The open end side of the coaxial probe 13 in this operation gestalt can also be

searched for as radiation field which make the source the electromagnetic-field distribution on an effective area. In the effective area of the coaxial probe 13, a part is emitted as it is and the remainder is reflected.
[0028] Namely, yL equivalent to the admittance in the effective area of the coaxial probe 13 It uses and relational expression with complex permittivity is given. This relational expression is a formula obtained by calculating electromagnetic field from the radiation edge of a measurement end face. Usually, the frequency of the RF to impress is [0029] below 30GHz.
[Equation 1]
$$y_L = \varepsilon_r^* + \xi \ \varepsilon_r^{*2}$$

[0030] It becomes a ****** type. It is specific-inductive-capacity epsilon* by solving this secondary complex equation. It is obtained. Therefore, if reflection of the electromagnetic wave in an effective area is measured, it will be specific-inductive-capacity epsilon*. Obtaining is possible.
[0031] Moreover, since the coefficient xi of the 2nd term can be disregarded on the frequency of 1GHz or less compared with the 1st term, it is [0032].
[Equation 2]
$$y_L = \varepsilon_r^*$$

[0033] It becomes still easier and it becomes possible to obtain specific-inductive-capacity epsilon* only by calculating yL equivalent to admittance. Specific-inductive-capacity epsilon* obtained here The concentration of a liquid 12 has a correlation.
[0034] Moreover, the underwater wavelength of 300MHz or more is set to about 33cm or less, and is lost, for example, if the wavelength is a problem also in the detection pipe 11. Furthermore, if a RF 300MHz or more is used as mentioned above, the attenuation factor in the inside of a liquid 12 will become high, the RF emitted into the liquid 12 from the coaxial probe 13 will decline in a liquid, and it will be hard coming to receive the influence of the opposite side of the detection pipe 11.
[0035] In quest of the dielectric constant of a liquid 12, concentration is computable by emitting microwave to a liquid 12 from the coaxial probe 13 as mentioned above, and the RF receiver's 26 receiving and detecting the intensity and the phase of a reflected wave in the liquid interface, and comparing with the microwave outputted from a high-frequency oscillator 25 by CPU24.
[0036] It is several cm, and since wavelength is long as compared with light, the wavelength in the inside of the liquid of a microwave range cannot be easily influenced of a very small scale, and its sensitivity to liquid concentration is higher than a microwave range compared with a long wave length band. Fundamentally, in a microwave range, the propagation is dependent on the constant expressed with complex permittivity. A dielectric constant, conductivity, and permeability are contained in complex permittivity, and the physical properties itself are expressed. There are the (1) coaxial probe method, (2) parallel plating method, (3) coaxial-track method, (4) S parameters, the free space method, etc. in the measuring method of the constant. To what has a comparatively high dielectric constant, the coaxial probe method of (1) is advantageous like [frequency is high and] solution. Especially this coaxial probe method can be computed if the reflection factor of the microwave in a probe end face is measured, and it is a very simple method.
[0037] Next, an actual measurement result is explained.
As a candidate for a [reflection factor measurement of solution] examination, the reflection factor in saccharose (sucrose) solution concentration, ethanol solution concentration, and glycol-ether (GE) solution concentration was measured. And specific inductive capacity is computed based on this measured reflection factor. Since the complex permittivity property was greatly influenced by the conductivity of the original water when it was made solution, water used what was extracted from the pure manufacturing installation (0.01microS/cm), and created the sample by weight concentration. Each frequency of each **** shows the reflection factor and phase for every concentration to drawing 3 , drawing 4 , and drawing 5 .
[0038] Drawing 3 is what showed the reflection factor R and phase M when measuring saccharose

solution, and (a) is a graph when the frequency of 0.3GHz and (b) use the frequency of 1GHz and (c) uses the frequency of 6GHz. Drawing 4 is what showed the reflection factor R and phase M when measuring ethanol solution, and is a graph at the time of using the frequency of 6GHz. Drawing 5 is what showed the reflection factor R and phase M when measuring glycol-ether (GE) solution, and is a graph at the time of using the frequency of 6GHz.

[0039] Fundamentally, if concentration becomes deep, a reflection factor will fall. Although a phase does not generally have ****** since criteria change with probe length, if concentration becomes deep, a phase will progress in this experiment. a reflection factor and a phase -- the data relevant to solution concentration in either were obtained Although it is dependent on the variation of a dielectric constant, or the temperature stability of a sample, when solution temperature changes with conditions like a drink restoration machine, as for sensitivity or an error, it is desirable to grasp a relation with concentration with the system.

[0040] the criteria dielectric after performing the calibration (amendment adjustment) of the measurement value in [calculation of dielectric constant] measurement section 23, in order to perform the calibration of the coaxial probe 13 first, after attaching a flange in the coaxial probe 13 and measuring the reflection factor in OPEN (opening) and SHORT (short circuit) -- brine concentration -- 10wt(s)% -- the inner reflection factor was measured and these were made into the data for calibrations The dielectric constant of an acetone and saccharose (sucrose) solution was computed on the basis of this data. Drawing 6 (a) shows the calculation result of the specific inductive capacity in each frequency of an acetone, and drawing 6 (b) shows the relation between the temperature for every saccharose (sucrose) solution concentration, and specific inductive capacity.

[0041] The measurement result of 0.0862 [**] was obtained from the physical-properties value of an acetone with standard deviation, and the specific-inductive-capacity measurement result according to concentration or temperature was obtained. In addition, it is thought that measurement from the quality of the material of these results and coaxial probes 13 to 0-90 degrees C is possible.

[0042] Proportionality amendment of the amount of reflection factor change of the side for measurement was carried out from the variation of the reflection factor by the side of a dummy load, using 50-ohm dummy-load amendment as a [measurement result in detection pipe] criteria element 18. The examination gave the temperature change on the way to the interconnection cable 22 between the coaxial probe 13 and the measurement section 23, and changed the propagation conditions in a cable a lot. At this time, the change in criteria and a cable has been amended below to 0.34 (=0.538%) with specific inductive capacity. Drawing 7 shows the error-correction result of the above-mentioned interconnection cable 22.

[0043] Moreover, specific-inductive-capacity measurement in the detection pipe 11 was performed. It is reflected within the detection pipe 11 and the microwave emitted from the coaxial probe 13 at this time is overlapped on the amount of reception. For this reason, a correction curve is required when loss of microwave is small. As variation in sucrose solution data, it was 3.087(=4.3%) at25.4mm in 1GHz with **0.419 (=0.735%) and loss small in 6GHz with large loss. Drawing 8 shows change of the specific inductive capacity when changing a detection pipe diameter.

[0044] By using the large brine of loss (attenuation) of microwave as an authentic sample in the process which computes specific inductive capacity from a measurement value as mentioned above, specific inductive capacity was measurable in root{(0.538%)2+(0.735%) 2} =0.938% precision so that clearly from the result shown in drawing 7 and drawing 8 .

[0045] (The 2nd operation gestalt) The 2nd operation gestalt of this invention is explained below. This 2nd operation gestalt shows the case where the sugar content of drink restoration equipment is controlled using the liquid density measurement equipment shown with the above-mentioned 1st operation gestalt.

[0046] Drawing 9 is the system configuration view of the concentration control unit for drink restoration concerning the 2nd operation gestalt of this invention. In addition, this 2nd operation gestalt shows aerated water to the container about the case where constant-rate restoration is carried out.

[0047] In drawing 9 , 31 is the syrup tank which stores simple syrup, agitates the treated water and sugar

which are supplied from the outside by the motor 32, and is taken as homogeneous simple syrup. The syrup stored by the above-mentioned syrup tank 31 is sent to the mixing tanks 35a and 35b through a pump 33 and a filter 34. Moreover, the drink undiluted solution and treated water which are different from the outside are supplied to these mixing tanks 35a and 35b. The above-mentioned mixing tanks 35a and 35b mix the above-mentioned syrup, undiluted solution, and treated water which are supplied from the outside by Motors 36a and 36b, for example, make them the syrup mixed liquor of concentration (sugar content) 50%.

[0048] Moreover, 37 is the deaerator (DEYUARETA) which stores and deaerates a treated water on a tank, and the treated water deaerated with this deaerator 37 is sent to mixed equipment (blender) 43 through the treated-water flow control valve 41 with a pump 38. Furthermore, the syrup mixed liquor stored by the above-mentioned mixing tanks 35a and 35b is supplied to this mixed equipment 43 through the syrup mixed liquor flow control valve 42 with a pump 39. The above-mentioned mixed equipment 43 mixes the treated water and syrup mixed liquor which are sent through regulator valves 41 and 42, and uses them as the drink of predetermined concentration. The concentration of this drink is adjusted by the opening of regulator valves 41 and 42 so that a detail may be mentioned later. The drink mixed by the above-mentioned mixed equipment 43 is sent to mixed equipment (carbo NETA) 46 through the concentration detector and condensator 45 which consist of the detection pipe 11 and the coaxial probe 13 which were shown with the 1st operation gestalt with the pump 44. This mixed equipment 46 mixes carbon dioxide gas (CO_2) to the drink by which concentration adjustment was carried out [above-mentioned]. The drink with which this carbon dioxide gas was mixed is sent to a filler 48 with a pump 47. While two or more restoration bulbs 49 maintain a fixed interval, are arranged in the shape of a circle and rotate one by one, the above-mentioned drink is filled up with this filler 48 into a container 50. The flow rate of the drink with which this container 50 is filled up is measured with a flowmeter (not shown), and when a setting flow rate is reached, the restoration bulb 49 closes it with the signal from a flowmeter.

[0049] And the detecting signal by the coaxial probe 13 of the above-mentioned detection pipe 11 is sent to the measurement section 23 through an interconnection cable 22. This measurement section 23 calculates concentration rho based on the detecting signal outputted from the coaxial probe 13, and inputs it into a control unit 51. This control unit 51 consists of amount operation part 52 of deflection, and control input operation part 53, and concentration value rhos (wt%W) of a main-control section (not shown) target is given to the amount operation part 52 of deflection.

[0050] The above-mentioned amount operation part 52 of deflection subtracts the measurement concentration rho from concentration value rhos of a target, calculates the amount e of deflection, and inputs the amount e of deflection into the control input operation part 53. This control input operation part 53 computes the control inputs v1 and v2 to regulator valves 41 and 42 based on the above-mentioned amount e of deflection, and outputs a control input v2 to the treated-water flow control valve 41 at a control input v1 and the syrup mixed liquor flow control valve 42. In this case, the above-mentioned control input operation part 53 computes control inputs v1 and v2 so that the amount e of deflection computed by the amount operation part 52 of deflection may approach zero.

[0051] The opening of the treated-water flow control valve 41 is controlled by the control input v1 outputted from the above-mentioned control input operation part 53, the treated-water flow rate q1 is adjusted, the opening of the syrup mixed liquor flow control valve 42 is controlled by the control input v2, and the syrup mixed liquor flow rate q2 is adjusted. In this case, the opening of the treated-water flow control valve 41 and the syrup mixed liquor flow control valve 42 is controlled so that the amount q of supply liquid flows adding the treated-water flow rate q1 and the syrup mixed liquor flow rate q2 ($q=q1+q2$) is always fixed (conditions given as a service condition).

[0052] The sugar content of a drink is controllable by the concentration of the drink with which a container 49 is filled up as mentioned above; i.e., this example, to always become a target sugar content. Therefore, a container 49 can always be filled up with the drink of fixed quality.

[0053]

[Effect of the Invention] While being able to simplify composition very much according to this

invention since attach a single coaxial probe in a detection pipe, output microwave from a high-frequency oscillator, input into a coaxial probe, a RF receiver receives the microwave reflected from the measured liquid in a detection pipe, intensity and a phase are detected and liquid concentration was computed in quest of the specific inductive capacity of a liquid based on it as a full account was given above, highly precise measurement is attained. Moreover, [near the detection pipe], while it prepares the circuit changing switch which changes an interconnection cable to a coaxial probe concentration detector or the reflective reference edge of microwave, this invention establishes a keeping-warm means to hold the temperature of this circuit changing switch uniformly, it measures, changing the aforementioned circuit changing switch, is under an amendment of the measurement value to a measured liquid, and can measure the intensity and the phase of reflective microwave with high degree of accuracy except for the influence by the interconnection cable.

[0054] Furthermore, this invention is set to the concentration control unit for drink restoration which is mixed through a flow control valve, respectively, adjusts a high-concentration drink and a high-concentration treated water to the drink of target concentration, and fills up a container with them. Since the opening of the aforementioned flow control valve was controlled so that the concentration of the drink mixed through the aforementioned flow control valve was measured with the liquid density measurement equipment using the aforementioned microwave and drink concentration turned into target concentration based on the measurement value It is controllable to become the concentration usual state of the drink with which a container is filled up with a target sugar content. For this reason, a container can always be filled up with the drink of fixed quality.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] Liquid density measurement equipment characterized by providing the following. The detection pipe with which a measured liquid flows inside The single concentration detector with which the nose of cam of a central conductor is inserted into the aforementioned detection pipe at least while being attached in this detection pipe and forming an insulator between a central conductor and an outer conductor The high-frequency oscillator which sends out microwave to the central conductor of this concentration detector through an interconnection cable An operation means to receive the microwave reflected according to the reflection factor in a liquid interface from the central conductor nose of cam of the aforementioned concentration detector through the aforementioned interconnection cable, to compute the specific inductive capacity of a measured liquid from the reflectivity and the phase of the microwave detected with the RF receiver which detects the reflectivity and the phase of the aforementioned microwave, and this RF receiver, and to compute liquid concentration from this specific inductive capacity
[Claim 2] a measurement value [as opposed to / measure establishing a keeping-warm means to hold the temperature of this circuit changing switch uniformly, and changing the aforementioned circuit changing switch, while preparing the circuit changing switch which changes the aforementioned interconnection cable to the aforementioned concentration detector or the reflective reference edge of microwave near the aforementioned detection pipe in liquid density measurement equipment according to claim 1, and / a measured liquid] -- an amendment -- the liquid density measurement equipment characterized by things
[Claim 3] The concentration control unit for drink restoration characterized by to control the opening of the aforementioned flow control valve so that the concentration of the drink mixed through the aforementioned flow control valve measures with the aforementioned claim 1 or liquid density-measurement equipment given in two in the concentration control unit for drink restoration which is mixed through a flow control valve, respectively, adjusts a high-concentration drink and a high-concentration treated water to the drink of target concentration, and fills up a container with them and drink concentration turns into target concentration based on the measurement value.

[Translation done.]